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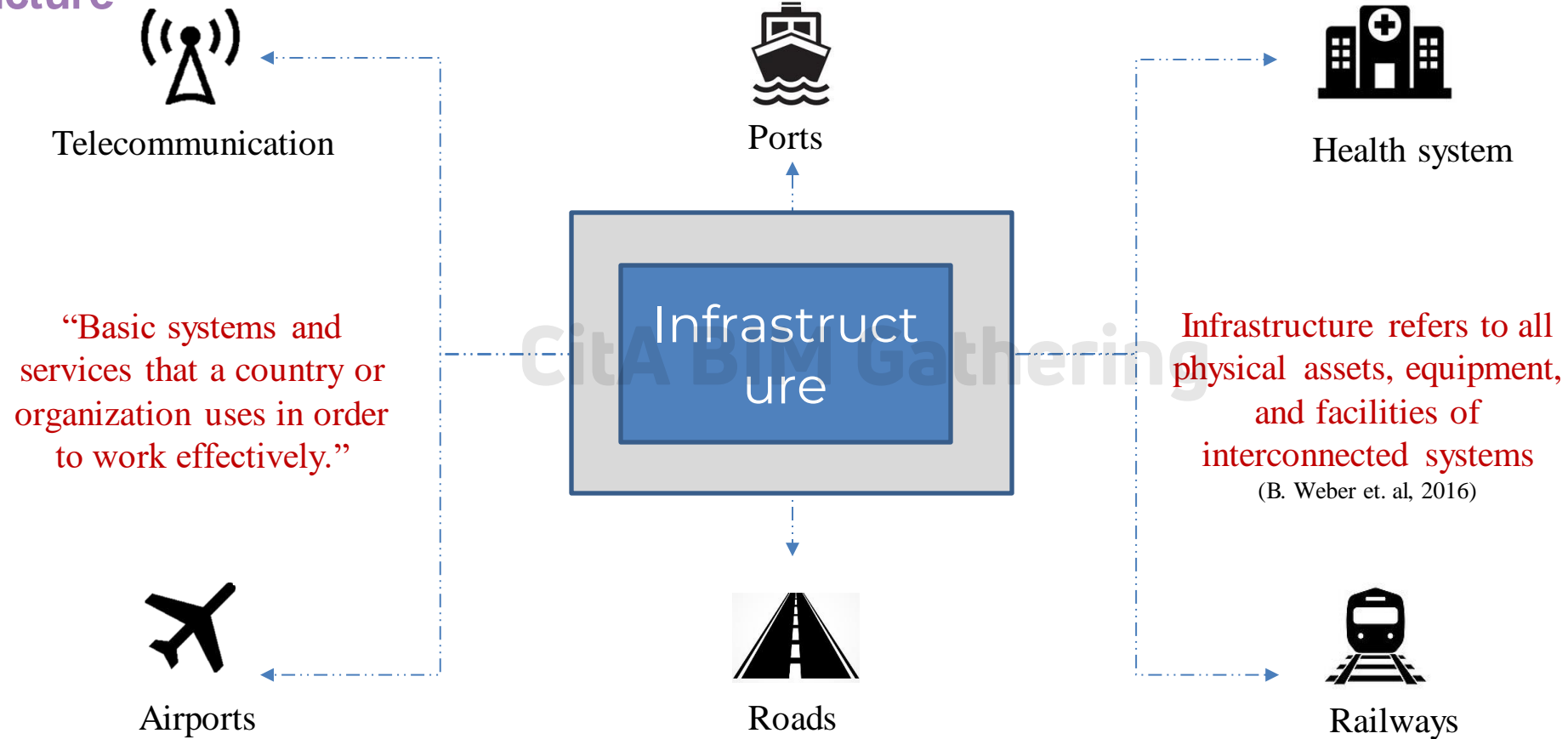# A Review on BIM Adoption in Indian AEC Industry: Barriers and Action Plans

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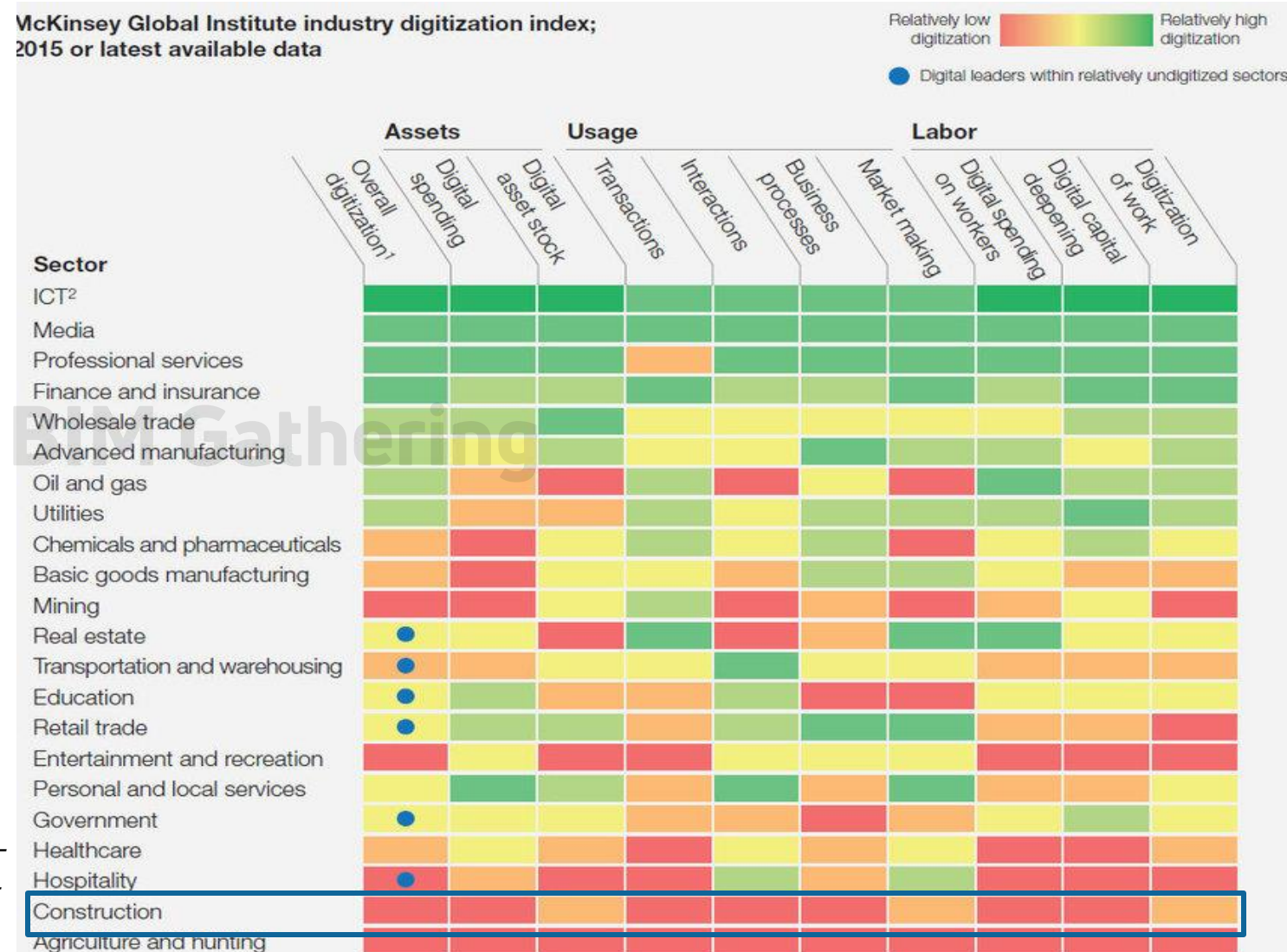Gathering23
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Infrastructure

Telecommunication

Ports

Health system

"Basic systems and services that a country or organization uses in order to work effectively."

Infrastructure

Infrastructure refers to all physical assets, equipment, and facilities of interconnected systems
(B. Weber et. al, 2016)

Airports

Roads

Railways

Construction is the least digitalized sector worldwide.

McKinsey Global Institute industry digitization index; 2015 or latest available data

Source : https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/digital-america-a-tale-of-the-haves-and-have-mores

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N-Dimensional BIM

3D
- It is also known as visualization phase
- 3D symbolizes the three geographical dimensions (x, y, and z) of a building construction.

4D
- It is also known as Time phase
- 4D BIM is the integration of the 'TIME' element to a simple 3D BIM model (Project Scheduling)

5D
- It is also known as Quantity and Cost phase
- 5D BIM is useful when budget analysis and cost estimation are necessary right from the start of a project.

6D
- It is also known as Sustainability and Energy Analysis Phase
- 6D BIM aids in the analysis of a building's energy consumption and the generation of energy estimates during the early stages of design.

7D
- It is also known as Operations and Maintenance Phase
- 7D BIM include improved asset and facility management from design to demolition, with simpler replacements and repairs of building components.

BIM as an Innovation

➢ BIM is a virtual process/technology that integrates all aspects, disciplines, and systems of an asset into a single virtual model (Lee et. al 2021).

➢ Team members (owners, architects, engineers, contractors, subcontractors, and suppliers) to collaborate more accurately and efficiently than traditional processes. (Lat et. al 2021).
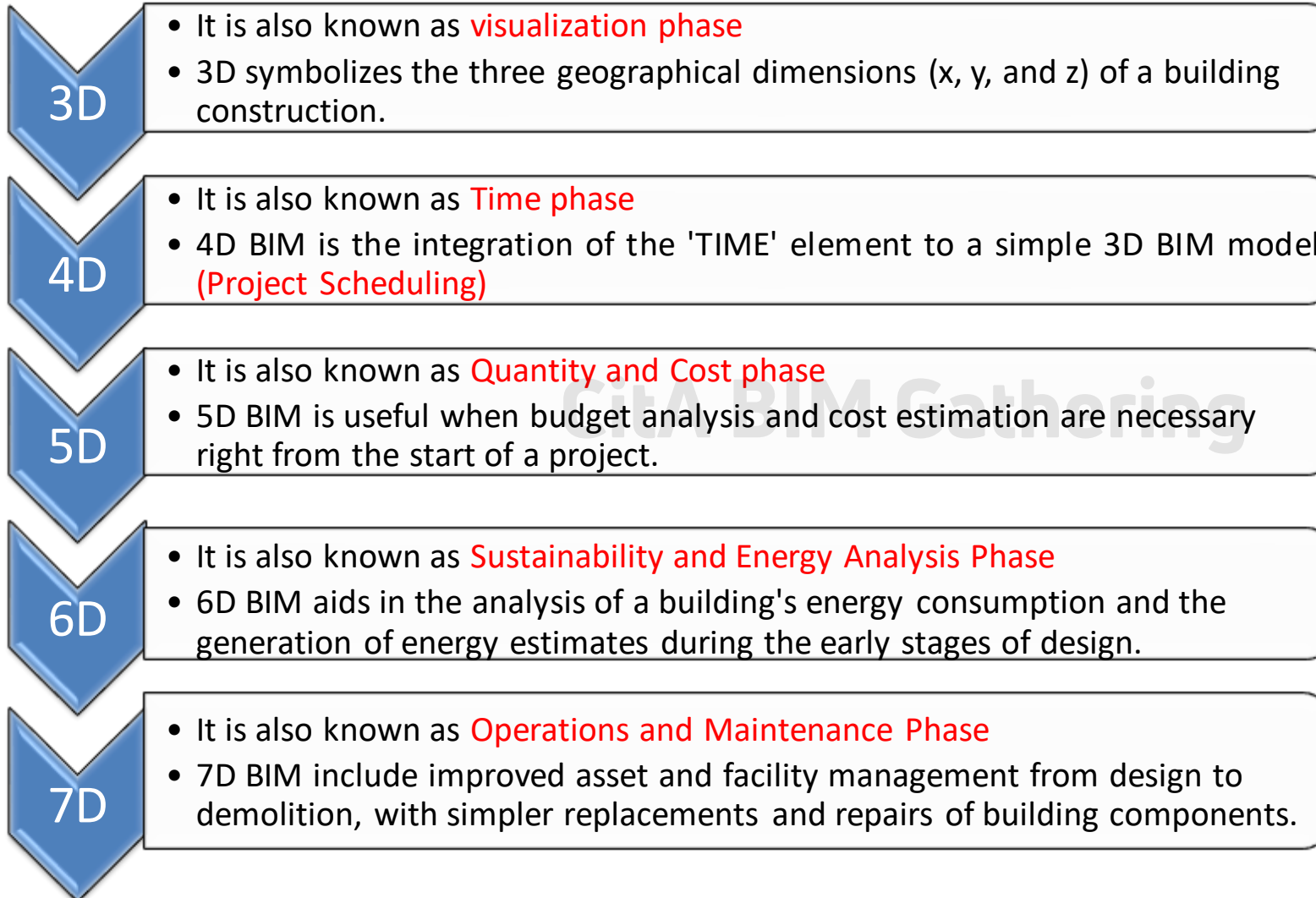
Softwares / Tools for BIM
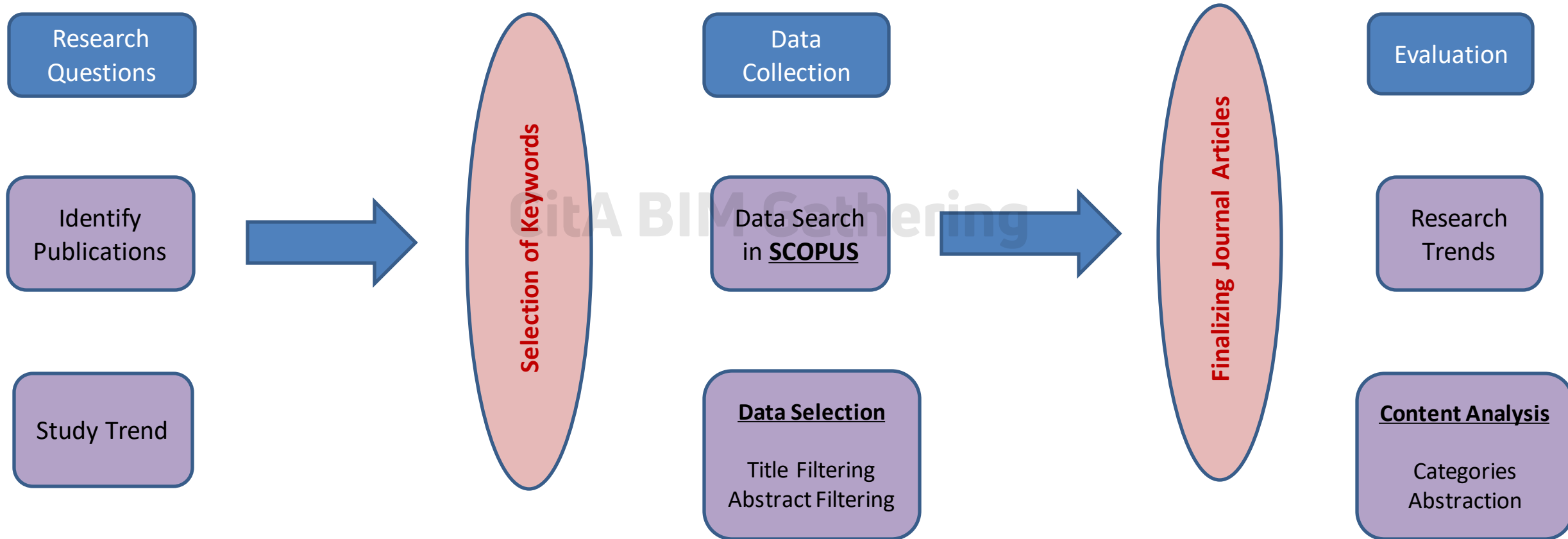
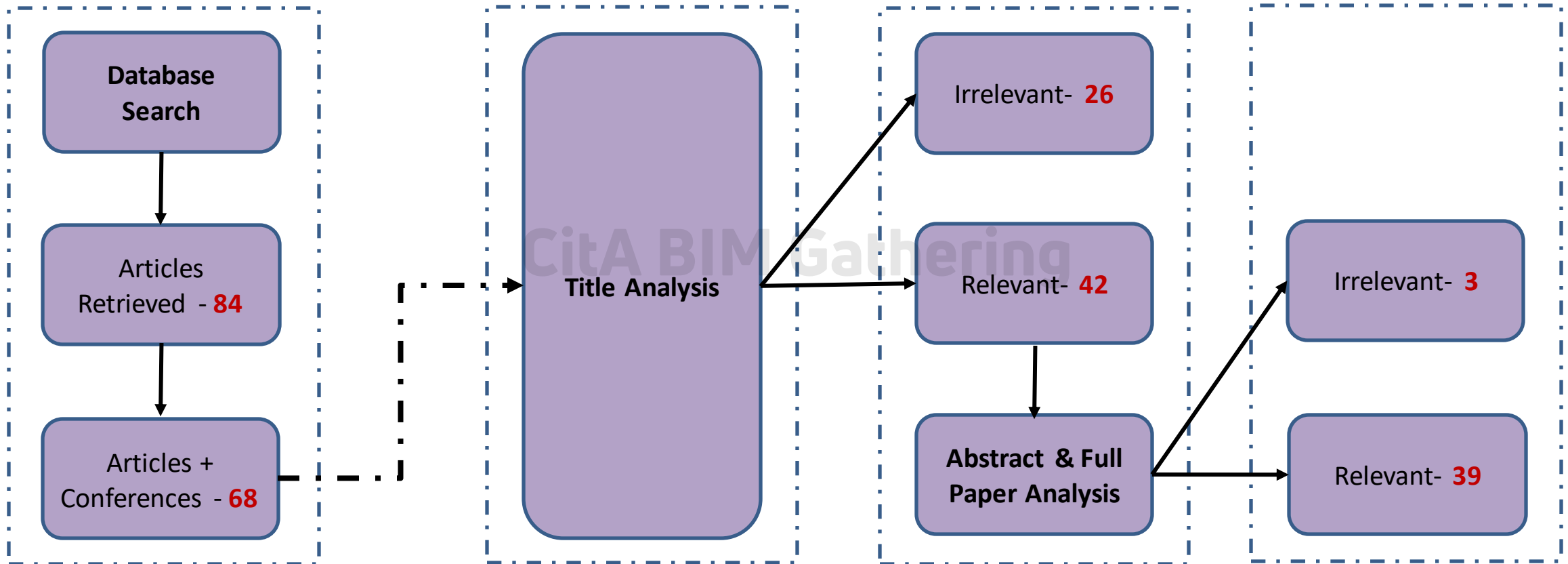## Need for Technology in Indian AEC Industry

- GOI has initiated National Infrastructure Pipeline (NIP) with the objective of achieving 5 trillion USD economy by 2024.

- 1.4 trillion USD has been allocated towards infrastructure development (2020-2025).

- A significant number of projects exceeds budgetary and scheduled timelines, faces challenges related to coordination and cooperation, due to implementation of traditional and inefficient project delivery methods in India. (A. Pal and A. Nassarudin, 2020; P. D. Shendkar and S. B. Patil, 2017; V. P. C. Charlesraj and V. Gupta, 2019)

- Out of 1,568 projects (value exceeding 150 crores), 423 projects were found to have incurred cost overruns, while 721 projects experienced delays. (Ministry of Statistics and Programme Implementation, May 2022)

The only way to increase productivity, quality and management of projects is through digitalization, novel construction techniques, and innovative measures. (H. Gao et.al, 2018)

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Systematic Literature Review: PRISMA

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Research Questions

Identify Publications

Study Trend
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Selection of Keywords

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Data Collection

Data Search in SCOPUS

Data Selection

Title Filtering
Abstract Filtering
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Finalizing Journal Articles

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Evaluation

Research Trends

Content Analysis

Categories
Abstraction
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A. Quantitative Analysis

Fig 1. Annual Publications

Table 1. Journal-wise Publications

No.	Journal	Papers
1	Asian Journal of Civil Engineering	**5**
2	Buildings	**4**
3	Institution of Civil Engineers	**2**
4	International Journal of Construction Management	**1**
5	Advances in Civil Engineering	**1**
6	Indian Concrete Journal	**1**
7	Gradjevinar: Journal of Croatian Association of Civil Engineers	**1**
8	International Journal of Applied Engineering Research	**1**
9	International Journal of Civil Engineering and Technology	**1**
10	International Journal of Recent Technology and Engineering	**1**
11	Journal of Advanced Research in Dynamical and Control Systems	**1**
12	Journal of Construction Engineering and Management	**1**
13	Journal of Engineering Science and Technology Review	**1**
14	Journal of The Institution of Engineers (India): Series A	**1**
15	Procedia Engineering	**1**
16	Smart Innovation, Systems and Technologies	**1**

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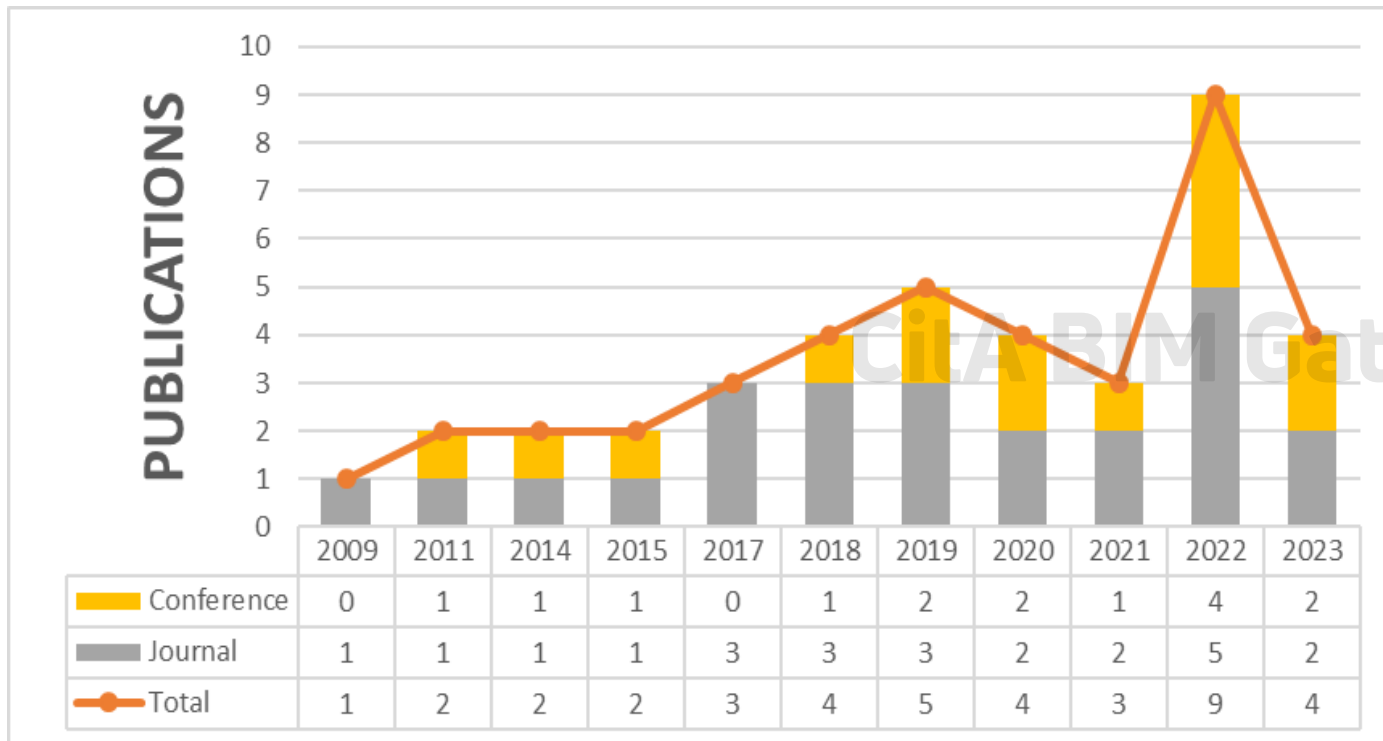
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B. Qualitative Analysis – BIM in India

- Indian construction industry has investigated the full potential of BIM but has not realized its benefits fully. *(S. Arunkumar et. al, 2018; R. Ahuja et. al,2020)*

- In the eastern region of India, the utilization of BIM is restricted to the domain of 3D modeling. *(A. Mohanta et. al, 2019)*

- There is a considerable level of awareness regarding 4D BIM, but its usage remains limited. *(V. P. C. Charlesraj and T. Dinesh, 2020)*

- A study in Kerala talks about the incorporation of indigenous architectural elements into the framework to promote the adoption of BIM in the context of residential developments. *(S. Surya and B. Tom, 2022)*

- A study was conducted to assess the viability of utilizing an integrated 5D BIM-based digital project management system for infrastructure projects (Metro Project). *(P. D. Pakhale and A. Pal, 2020)*

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B. Qualitative Analysis – Barriers in BIM Adoption in India

- A study investigated technological, organizational, and environmental factors that impede or facilitate the adoption of BIM among architectural firms in India. *(R. Ahuja et. al,2020)*

- The obstacles identified in the implementation of 4D BIM are the absence of internal workforce proficiency, dependence on conventional project delivery approaches and contracts, and shortage of 4D BIM expertise in the market *(V. P. C. Charlesraj and T. Dinesh; 2020)*

- The majority of studies found out that cost-based factors which includes higher costs for software, hardware and cloud based systems, staff training etc. are major barriers affecting BIM implementation in India. *(S. Sreelakshmi et. al, 2017; A. Arokiaprakash and K. Aparna 2018)*

- Lack of familiarity and understanding of BIM, reluctance to acquire the necessary skills and adapt new methodologies, and a preference for traditional techniques are significant obstacles in India. *(M. E. Murphy 2014; S. Hire et. al;2021)*

- The barriers in implementing BIM in India includes cultural, legal, lack of skill-sets and competence, economic and management related factors. *(B. Srikanth et. al; 2023)*

- A study based on 5D BIM implementation in India identifies eight primary challenges, which were categorized into three groups: personnel-related issues, process-related issues, and technological limitations. *(S. Gaur and A. Tawalare,2022)*

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B. Qualitative Analysis – Action Plans for BIM Adoption in India

- In order to promote wider acceptance and utilization of BIM in India, it is crucial to conduct a thorough analysis of the benefits and drawbacks associated with the integration of BIM capabilities at the organizational level. (R. Ahuja et.al, 2016)

- Academic measures and policy recommendations were proposed to facilitate the successful implementation of BIM for the management of heritage buildings. (B. C. Roy and V. Pawar, 2022)

- Crucial modifications for both individuals and the discipline, strategies to overcome obstacles, and efficient approaches to implement BIM capabilities in the Indian construction industry is required. (N. Aarti and G. Zhili, 2014)

- Enhancing communication, collaboration and transparency among all four important stakeholders i.e., client, consultant, designer, and contractor. (S. Gaur and A. Tawalare, 2022)

- BIM in India is perceived as being driven by government mandates and the desire for a return on investment (ROI). (V. P. C. Charlesraj and T. Dinesh, 2020)

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Innovation Diffusion Theory

➤Innovation diffusion Theory (IDT) investigates the mechanisms, drivers, and diffusion patterns of novel concepts and technological innovations across diverse societies. (E. Rogers,1962)

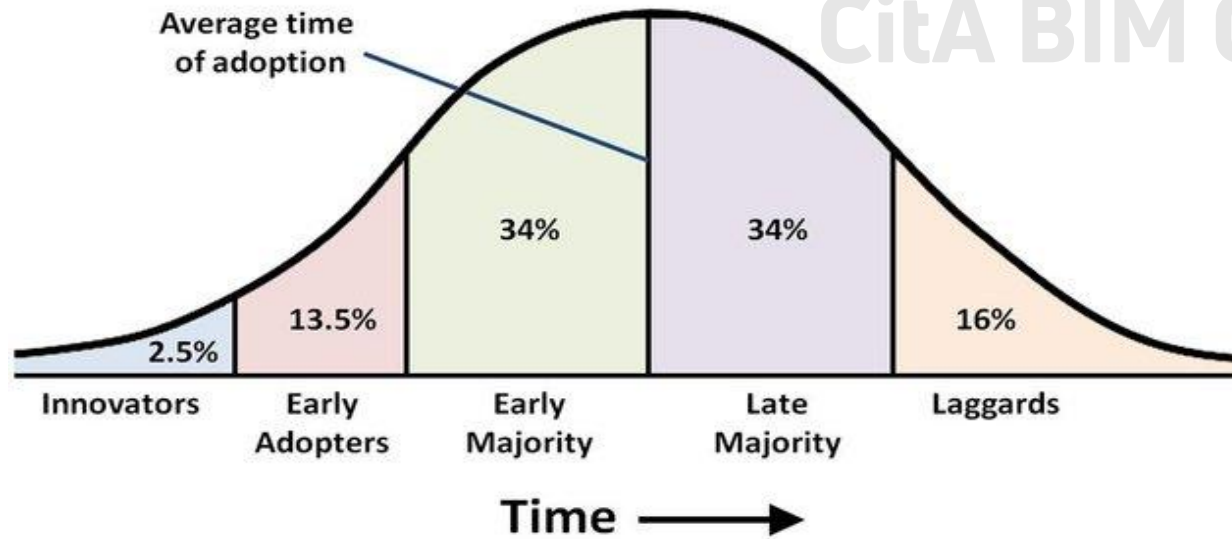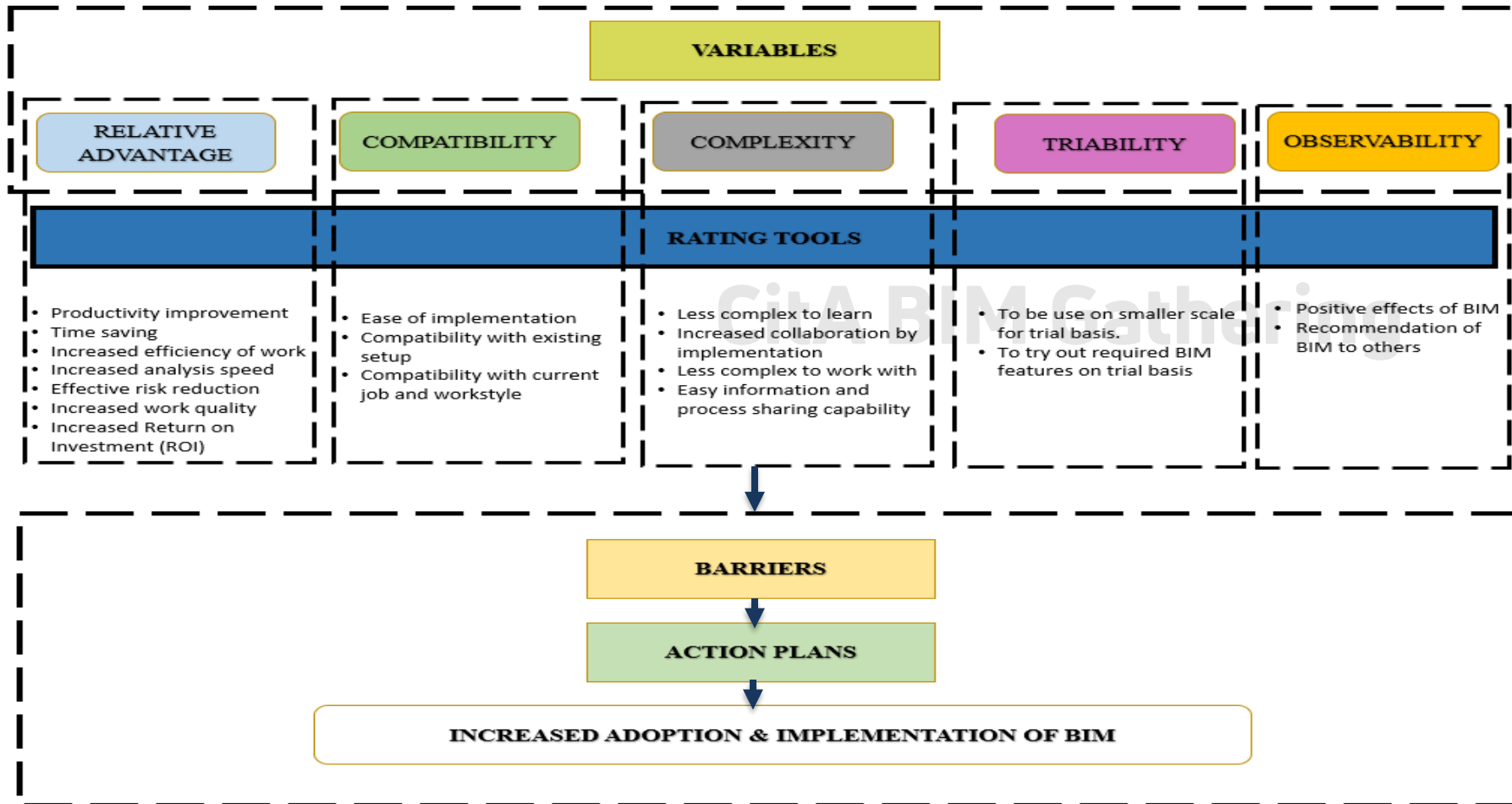➤IDT has been used to understand BIM adoption in Australia, Iran, UK, China and Korea.

Fig 2. Innovation Diffusion Model (Rogers,1962)

Five main factors that influence adoption of an innovation

✓ Relative Advantage

✓ Compatibility

✓ Complexity

✓ Triability

✓ Observability

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Conceptual Framework

- The variables encompass a range of rating instruments that comprehends the significance and efficacy of a technology being examined.

- The significance of the barriers can be evaluated using an importance index, and then suitable action plans can be taken to eliminate them.

- Hence, through the utilization of this model, a higher uptake and execution of BIM in the construction industry of India can be experienced.

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Conclusions

- The present research reveals that the Indian AEC sector has not entirely adopted digital technology such as BIM, and contributes to comprehend the current state of BIM advancement in India

- A systematic analysis of the research contributions pertaining to the barriers and action plans for successful implementation of BIM in India necessitated an overview of the relevant studies

- A systematic literature review was conducted utilizing the PRISMA technique and the SCOPUS database and 39 articles were retrieved.

- The aforementioned conceptual framework can be employed by stakeholders in the Indian sector to comprehend and choose the necessary BIM tools required during various lifecycle phases of a project, considering their comparative advantage, compatibility, complexity, triability, and observability- **IDT.**

- This study could potentially function as a valuable reference for experts and policymakers seeking to improve the digital footprint of the construction industry in India.

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Limitations & Future Scope

- To enhance the study's comprehensiveness, it would be beneficial to include papers from multiple databases and government reports.

- As part of future scope, it is imperative to conduct an empirical and survey-based study to comprehend the extent to which different barriers and corresponding action plans can influence the adoption of BIM in India

- The conceptual model presented in the research is of a generic nature and can be refined through a comprehensive understanding of the diverse population types (based on IDT) that exist within the Indian construction industry.

- The research can be further improved by incorporating the Technology Acceptance Model (TAM) theory with the Information Diffusion Theory (IDT), as demonstrated by scholars in different nations

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THANK YOU